

Croatian Journal of Education
Vol.20; Sp.Ed.No.1/2018, pages: 25-45

Original research paper

Paper submitted: 15th January 2018

Paper accepted: 7th February 2018

<https://doi.org/10.15516/cje.v20i0.3049>

LEGO Material in the Programme of Early Childhood and Preschool Education

Nataša Cvijanović¹ and Danica Mojić²

¹Ministry of Education and Culture of the Republic of Srpska

²Children's Kindergarten Čika Jova Zmaj in Bijeljina

Abstract

The paper presents the possibilities and conditions for applying the LEGO DUPLO Play Box material and the effects of its use on child development, as well as on the work of kindergarten teachers. It is based on the research carried out in four preschool institutions in Bosnia and Herzegovina that were included in the project "Application of LEGO construction material in preschool institutions". Within the project, the material and teacher training for its use were provided by the Danish LEGO Foundation that supports the realization of such activities in the South African Republic, Mexico and India, and, in European region, in Ukraine and Bosnia and Herzegovina. During the research, thirty kindergarten teachers were assessing the possibilities and conditions for the application of the LEGO DUPLO Play Box material through the Assessment Scale of the application of LEGO material in the Programme of Early Childhood and Preschool Education. The effects of the application of the LEGO DUPLO Play Box material both on the development of the child and on the work of the kindergarten teachers were monitored through the Protocol for Observing Learning Activity in which LEGO material is used, in relation to the kindergarten teachers and regarding the aspects of child development. The results of the survey show that the community as a factor does not provide significant support in terms of promoting and emphasizing the importance and significance of the construction play for children and for their further development, and that the institutional factor (associations, organizations, stores selling toys) does not sufficiently promote the importance of play. In addition, the effect of the application of LEGO material in the Programme of Early Childhood and Preschool Education has been confirmed, but only in the context of the work of kindergarten teachers. The effect of the application of LEGO material on the aspects of child development has not been observed, which

means that there is no difference in achieving the expected outcomes of children's learning during the application of the Programme with or without LEGO material. This implies that the implementation of the entire Programme of Early Childhood and Preschool Education in the Republic of Srpska, Bosnia and Herzegovina is based on play, as well as on the construction play, but also that with the application of LEGO materials it is possible to achieve the planned learning outcomes and thus encourage the development of the child in all their aspects.

Key words: *aspects of child development; construction material; pedagogical perspective of play; playing activity; social-ecological theory.*

Introduction

Children's nature and their tendency towards active participation and interest in the environment in which an activity takes place, whether it is play, a playing activity, or everyday activity¹ of a child, can be seen in the connection between a child's play on the one hand and early learning on the other hand. A child plays for his/her own pleasure, satisfying the basic needs and developing creative and intellectual skills. However, for children, play is neither entertainment nor a useless waste of time, because while playing a child tries to "overcome the gap between his/her own possibilities and patterns of behaviour that (s)he has to adopt in order to successfully enter the social environment and therefore puts in all his/her strength, skill and patience, which is rarely noticed in some other activities" (Spasojević, 2013, p. 171). Thus, we can really see play as a complex human activity that relies on many different aspects (Kamenov, 2006, p. 7).

In terms of understanding play from the aspect of psychological theories relating to the knowledge and development of a child, we can say that play is often analysed in relation to the development of cognitive abilities, which are especially important for the development of symbolic functions (Kamenov, 2006, p. 12). So, through play, the child shapes symbols which mediate between a person and the reality that surrounds him/her. Thus, "a child's play is not simply a memory of something experienced, but creative processing of previous impressions, a process of combining them and creating new reality out of them that corresponds to the demands and interests of the child himself" (Vygotsky, 2005, p. 21). In contrast to Piaget, Vygotsky does not see motives for play in intellectual curiosity, but in reducing frustration in an affective conflict which occurs when a child is not able to satisfy his/her aspirations (Kamenov, 2006, p. 13). In such a situation, a child reflects the level of current development on the one hand, whereas, on the other hand, while playing they try to act in the zone of the nearest, next developmental phase. Therefore, a child is "always above his average age, above his ordinary daily behaviour" (Kamenov, 2006, p. 14; Rossen, 2013) while

¹ In foreign literature we often find the term "routine" for such activities.

playing. Then, there is a strong motivation for inclusion into the adult community (Ivon, 2010, p. 20). This inclusion in the adult world and managing social reality gives the child a chance to gain through play the knowledge of relationships between people, thus shaping his/her attitude towards the world and life in general.

From the first day of life children explore the world through play, thus acquiring knowledge as an accompanying factor of spontaneous learning. For children, play is their arena for building knowledge in which, through playing, they integrate processes that lead to the development of intellectual abilities, development of social skills, understanding of the feelings that the environment and the world inflict upon them. Thus, play becomes the most important and dominant activity in childhood, through which children express their needs and social aspirations, psychological, physical and emotional states.

Some authors emphasize the concept of play as a “medium” for learning and development (Bergen, 1998, p. 7), with play as the main instrument by which children’s development and learning is initiated and realized. All human beings are active in search of knowledge, and play is an integral part of this search process. The pedagogical value of play does not lie in its use as a way to teach children a certain set of skills through structured playing activities, but in the fact that play is a natural environment for children and a state in which a wide range of learning can flourish. It supports all the developmental functions required in a natural environment (Bergen, 1998, p. 8), such as more perfect functioning of children’s cognitive, social, emotional and physical structures. Natural environment is the one in which every organism develops best, and for children this natural environment is play.

Through play children transfer their experiences into internal thinking processes; thus, by observing children’s play, adults can understand the complexity of children’s thinking processes and the intensity of their feelings. Also, through play, children achieve their immediate goals and convey their deepest thoughts and feelings. Children convey to the public their state of affairs, level of development and their mood through play, as well as through drawings and stories, and thus play can provide an active and safe environment which helps children express their emotional states (Asher & Rose, 1999, p. 285). Play is the main mechanism through which children explore their environment and in such a way play becomes a natural mechanism of motivating children to learn about themselves and the world surrounding them. To what extent a particular aspect of child development will be supported depends on the kind of play that a child is involved in.

The generally accepted definition of play includes three major categories: 1) sensory motor play; 2) symbolic play that includes fantasy play and dramatization play, and 3) construction play involving the creation of symbolic products from wooden blocks, LEGO blocks or similar materials (Piaget, 1962; Wolfgang & Wolfgang, 1999).

Play with blocks, as a form of construction play and as one of the central activities of preschool children, requires a child to use a large number of construction pieces

during the game in which a child creates new objects that represent the imaginary structure of real objects (Hirsch, 1996). Construction play gives a preschool child the ability to classify, measure, order, count and compile differences in relation to depth, width, length, symmetry, shape and space (Hirsch, 1996). Some authors call construction materials (blocks) a “super toy” in terms of thinking about development, learning, problem solving, creation, and child interaction (Frost, Wortham, & Reifel, 2012, p. 252). In a study on free play of preschool children with 64 different materials in a group, only one toy achieved the highest scores, which signified the value of the game, and those were construction materials (Travick-Smith, Russell, & Svaminathan, 2010). Construction materials most easily encourage children to express themselves creatively. More than other toys, playing with blocks has helped children to be imaginative and think creatively. In this research, play with blocks has a significant role both in solving problems and convergent thinking. In addition, construction play had the highest ratings in the influence on social interaction and use of language, because children, while constructing together, often talk, exchange ideas and thus plan their “construction structures” (Travick-Smith et al., 2010) through two very important operations: *visual discrimination and interpretation of abstract symbols* (Hirsch, 1996). Such results have been confirmed by other studies that pointed to the important bond between playing with construction materials and the ability to navigate in space, the creation of mental images, mathematical abilities (Caldera, Culp, O'Brian, Truglio, Alvarez, & Huston, 1999; Oostermeier, Boonen, & Jolles, 2014; Pirrone, Nicolosi, Passanisi, & Di Nuovo, 2015), communication skills (Ramani, Zippert, Schweitzer, & Pan, 2014) and speech development (Ferrara, Hirsh-Pasek, Newcombe, Michnick Golinkoff, & Shallcross, 2011). These are important for strengthening the cognitive abilities that form the basis for formal thinking, but it should also be noted that the significance of this relationship is lost in children from the third to the fifth grade of primary school (Wolfgang, Stannard, & Jones, 2003).

Children of different age approach play with blocks differently, so that seven levels can be identified in the process of “construction” (Hirsch, 1996). Two-year-olds first carry the blocks, without intending to make the construction; three-year-olds perform horizontal or vertical *stacking*, thus they *bridge* the two blocks, connecting them, while at the age of four they begin to create space with such blocks (*fencing*). At the age of five, the *patterns and symmetry* are already recognized and reflected in the balanced structure, when *early representativity* (designation of the structure before the construction begins) and *late representativity* (designation of the structure created during or after the constructive game) begin (Hirsch, 1996).

LEGO Material between Constructivism and Constructionism

Piaget's structural theory of development is based on the understanding that every child is going through the established developmental stages equally, but also that the pace at which it happens depends on the cultural and environmental conditions,

which means that the mental functions are more genetically and less culturally and socially determined (Woodhead, 2012, p. 44). A more fundamental question than his theory of developmental stages is his view that knowledge is not simply “acquired” by children step by step, but built up into a coherent knowledge structure. Children build up these structures based on their own experience during the process of growing up. He found that children are not only passive absorbers of experience and information, but active builders who construct and rearrange knowledge based on their experiences growing up in the world around them (Piaget, 1962; Piaget & Inhelder, 1978). This is why Piaget’s theory of development is sometimes referred to as the theory of individual constructivism, which means that individuals construct knowledge through interaction with their environment (Hussain, Lindh, & Shukur, 2006).

Based on Piaget’s constructivist theory, Seymour Papert and his colleagues at MIT in Cambridge, Massachusetts, USA, developed a theory of learning, calling it the theory of constructionism (Papert, 1980). It includes everything that is related to the constructivism of Piaget, but Papert goes on, claiming that constructivist learning occurs particularly well when people participate in the creation of something. This new knowledge allows them to build even more sophisticated things. Constructionism is a part of the philosophy of education that negates the “obvious truth” (Papert, 1993, p. 139), because each person “reconstructs” the information that is being transmitted to them, and so constructivism starts in the head, while “thought construction” occurs as its product. Although both authors, Piaget and Papert, developed their own theory through observation of behaviour and learning during children’s activities, Papert, in particular, believes that these results are equally applicable to adults. He wanted to create a learning environment that is more favourable than the standpoint set in Piaget’s theory. He considered the school environment to be too sterile, too passive, dominated by a clearly structured teaching process, and such an environment does not allow children to become active builders of their own knowledge.

Papert first began to think about constructivism in the late sixties after observing a group of students who actively participated in solving the assigned task (making a sculpture out of soap), and he noticed several things: the level of their engagement, the elements of creativity and originality during creation of the actual product; interaction and cooperation among students, and the general sense of entertainment and enjoyment that has been enriched by this experience (Papert, 1980). Being a mathematician by profession, reflection on these students led him to the idea, so in the 1970s he designed a computer programming language called the Logo that allows children to use mathematics through the creation of images, animation, music, game and simulation (among other things) on the computer. In the mid-1980s, members of his team developed the LEGO TC Logo, which enabled children to control the design of the LEGO structure, thus creating computer programs that provide them with a new mathematical experience. Such orientation has created space for examining the educational value of many computer games (Holbert, Penney, & Wilensky, 2010). This

knowledge led him to conclude that “better learning will not come from finding better ways of teaching by teachers, but by giving pupils better opportunities and learning conditions” (Hussain, Lindh, & Shukur, 2006), stressing the importance of the context for learning and the situation in which learning takes place, in a theory known as *contextually appropriate practice* (CAP, Bredekamp, 1996).

Children’s Play and the Programme of Early Childhood and Preschool Education

The Programme of Early Childhood and Preschool Education in the Republic of Srpska, Bosnia and Herzegovina is based on the principle of play² as the dominant children’s activity. It is based on contextually appropriate practice, taking into consideration the context in which children learn, the material and cultural resources available to them, their parents and the community they live in (Woodhead, 2012, p. 40). This clearly indicates that developmentally appropriate practice (DAP) was taken into account in the development of this Programme, bearing in mind that many leading associations for education of children at early stage of their development support the creation of guidelines for the developmentally appropriate practice. This practice is based on the curriculum and incorporates play and self-initiated play activities of children (Wolfgang et al., 2001). It is very important to provide “enough play” during the implementation of the programmes for early learning, which means that the programme should be based on the principle of domination of play and play activities.

However, in terms of the relationship between play and the preschool programme, play was often underestimated as the curriculum-based means of kindergarten teachers and parents, primarily because the learning aims, especially in schools, are often narrowly defined in terms of mastering a set of basic academic skills. This emphasis on learning the basic academic skills has been changing in recent years, which is best seen through the introduction of basic tests to test the skills at different age levels. Although it is certainly important that all citizens master the basic academic skills, work-oriented approach to learning is also important (Bergen, 1998, p. 8). Advocates of play believe that educational goals for citizens in the IT age in the society of the future will be better defined through playing activities for both children and adults. Indeed, many of the recently developed approaches to curricula in mathematics and literacy recognize the need for children to play with ideas and thus through their play activities, build their knowledge of content in these areas (Bergen, 1998, p. 8; Oostermeier et al., 2014). Future kindergarten teachers and school teachers will have to know and appreciate the values of play and the possibility of its articulation within the

² “The principle of domination of play and play procedures indicates that children’s play and development are mutually conditioned and that the child turns his/her life activity into play. Play is the life of a child and the most natural form of learning. In play, the child behaves more perfectly than in ordinary life, which speeds up the development, while at the same time, quicker development opens up new possibilities for the influence of play. In early learning programmes, play is an indispensable tool and as such requires much greater respect” (*The Programme of Early Childhood and Preschool Education*, 2007).

programme in terms of providing quality support and creating a favourable learning environment, because by accepting play as “natural environment” of a child and as a learning medium, set as “didactic modality or pedagogical style” (Cecchin, 2013, p. 56), play will best influence the richness of their experience, their development and learning.

Based on the concept grounded on the system of learning activities and play, the *Programme of Early Childhood and Preschool Education* was adopted in the Republic of Srpska in Bosnia and Herzegovina in 2007 and a major change in the way of work in preschool institutions was made. The concept in which preschool education was carried out within a subject area³ through frontal form of work, “using the most common verbal method at a precisely determined time with a standardized duration according to the age of children: with younger groups, 15 minutes, with middle groups 20, and with older groups twice 25-30 minutes, was abandoned” (Petrović-Sočo, 2009, p. 125). Thus, the traditional programme/curriculum, which is based on the transmission of knowledge, where kindergarten teachers transferred the content to the children they were teaching, has been replaced by the modern multifunctional curriculum of humanistic metaorientation (Mojić, 2010), with emphasis placed on the child, not on the kindergarten teacher, on the processes, rather than on the learning outcomes (Cvijanović, 2017). The programme relies on the network of learning outcomes, as well as all aspects of child development⁴. The emphasis of this Programme, which does not have a strictly defined structure, is placed on an open, flexible organization of the educational process, in an environment where the child has many opportunities to learn and live together with other children.

Under such circumstances, introduction of more intensive use of LEGO material in the practice of preschool institutions of the Republic of Srpska, Bosnia and Herzegovina based on the mentioned Programme was expected not to be difficult. By engaging in the project “Use and application of LEGO construction material” in four preschool institutions, each learning activity defined by the Programme, as well as guided play, was realized using the construction LEGO material through the learning centres, and once a week a LEGO Day was organized, when all activities in the kindergarten were implemented with the help of LEGO material.

Method

Through *systematic observation* and based on theoretical analysis, the method and models of applying the LEGO DUPLO Play Box material in four preschool institutions in the Republic of Srpska in Bosnia and Herzegovina were defined.

³ Physical education, art education, music education, mother tongue, learning about natural and social environment and acquiring basic mathematical concepts.

⁴ Physical, social and emotional, intellectual aspect and development of speech, communication and creativity.

Identification of the possibilities and effects of the use of the *LEGO DUPLO Play Box* material in the work of preschool institutions was carried out through a *survey* research during which we tried to examine the relationship between the use of the design material *LEGO DUPLO Play Box* in the practice of kindergarten teachers and the aspects of preschool children development, which was also the *goal* of the research.

The first research task was to examine the possibilities and conditions for the application of the *LEGO DUPLO Play Box* material in preschool institutions with regard to the self-assessment of kindergarten teachers in the context of the socio-ecological theory (SET) (McLeroy, Bibeau, Steckler, & Glanz, 1988).

The second task of the research was to determine whether there is a connection between the use of LEGO material and a) planning the learning activities, b) the introductory part of the learning activities, c) the main part of the learning activities, d) the final part of the learning activities, and e) free children's play.

During the third research task we tried to examine the effects of the use of the *LEGO DUPLO Play Box* material in the preschool institutions' practice based on the *Programme of Early Childhood and Preschool Education*. That is, we tried to determine whether the use of the *LEGO DUPLO Play Box* material contributes to greater expression of the aspects of preschool children's development if used during learning activities.

The starting point for this research was that the application of the *LEGO DUPLO Play Box* material as curricular means in the practice of preschool institutions had still not been clearly defined, and that by using this material it is possible to achieve the planned learning outcomes and thus encourage the development of the child in all its aspects.

Based on the assessment of the kindergarten teachers by means of *scaling*, the possibility of using construction material in the preschool programme in relation to the conditions in which the preschool institution operates, considering the conditions through five related factors of social and ecological theory, was examined. At the end of the 1980s, based on Bronfenbrenner's Ecological Theory (Bronfenbrenner, 1986), as well as knowledge about child development, McLeroy et al. (1988) developed a theoretical framework that emphasizes the importance of the social and ecological context in which an individual grows and evolves. McLeroy et al. (1988) identified five related factors that influence the behaviour of an individual: 1) intrapersonal factor - includes individual characteristics such as knowledge, abilities, attitudes; 2) interpersonal factor - a human factor that includes social networks such as friends, neighbours, families; 3) institutional factor - includes a context such as formal and informal rules, management support; 4) community factor that includes norms and standards that exist between groups and within organizations, and 5) public policy - includes local, regional and national policies. As we can see, the social-ecological theory (SET) includes many different factors that influence the behaviour of an individual, which on the one hand represent the advantage of this theory, and on the other hand, this same comprehensiveness produces one of its greatest limitations in

practice. However, the explication of this theoretical framework gets full meaning if during observation specific contexts and participants are taken into account. Thus, in the context of our research, the challenges of kindergarten teachers are observed related to learning through play. SET theory will help us understand the complex challenges faced by kindergarten teachers better while answering the questions such as: How can a policy affect the behaviour of kindergarten teachers, that is, to encourage them to use play in kindergarten practice more?

The *Assessment scale on the possibility of using the LEGO DUPLO Play Box material in the Programme of Early Childhood and Preschool Education* was constructed on the model of the examination instrument of Meghan Lynch, who, due to nethnographic⁵ study of understanding social interactions and experiences based on socio-ecological theory, studied the views of 78 kindergarten teachers on using play in preschool institutions in the United States (Lynch, 2015). By preliminary testing of asymmetry and flattening (skewness, kurtosis), the assumptions of normality of distribution were examined, while Cronbach's Alpha coefficient determined the reliability of the use of the LEGO DUPLO Play Box material ($\alpha = .61$) for the proposed scale, since three items were determined for each subscale (Table 1).

Table 1

Descriptive data of the Assessment scale on the possibility of using the LEGO DUPLO Play Box material in the preschool institution





Scale	X	s δ	skewness	kurtosis
Intrapersonal factor	4.79	0.42	-1.83	1.00
Interpersonal factor	4.51	0.55	-0.99	0.21
Institutional factor	2.17	0.82	0.52	0.37
Community factor	3.32	0.57	0.49	1.51
Public policy	4.69	0.40	-0.85	-0.99

The second instrument used in the research is the *Protocol for observing learning activities in which LEGO DUPLO Play Box material is used*, and which is constructed to represent two parts, with reflection on: 1) the kindergarten teacher and 2) the aspects of child development. The reflection of applying the *LEGO DUPLO Play Box* material in relation to kindergarten teachers was recorded with the Likert-type scale for the items which were included in the instrument based on the defined *LEGO steps for kindergarten teachers*, presented to the kindergarten teachers during the training organized by the LEGO Foundation for the usage of this material. LEGO steps for kindergarten teachers include: planning, linking to the topic in the introductory activity, constructing knowledge through work in small groups, and talks during the main part of the activity and the question *what else can be done* within the final activity (Table 2).

⁵ Nethnography – a method of online research and understanding of social interactions; an interpretive method of research that adapts to traditional observational techniques by manifesting them through digital communication.

Table 2

LEGO steps for kindergarten teachers- an example of a methodological model for applying LEGO materials in educational practice

What is the role of kindergarten teachers at each phase?	
<p>Introductory activity (linking)</p> 	<p>Introductory activity - linking to the topic:</p> <ul style="list-style-type: none"> - outings with children and parents (ZOO, an ethno village, a river, a castle, a village household, etc.); - a picture book; - a theatre play; - broadcast on television or a cartoon; - a story following a series of pictures, etc.
<p>Construction (work in small groups):</p> 	<p>Construction of Knowledge - talking about what we have seen:</p> <ul style="list-style-type: none"> - using LEGO materials we divide the children into small groups and each group receives a task (e.g., to build a bridge that will be safe to cross); - children are offered basic blocks, and the rest is placed in a special place in the room from where children will be able to take the blocks they need; - during the construction process, kindergarten teachers monitor groups and encourage children to realize their ideas;
<p>Designing (conversation):</p> 	<ul style="list-style-type: none"> - when each group completes the task, they all look at their constructions, walking from one group to another, and the children explain what they did and how; - the kindergarten teacher asks questions: What does each group have in common? What do you need to do, for example, to make the bridge safer? What will happen if there is no fence on the bridge?
<p>Final activity (continuation, what can we do next?)</p> 	<ul style="list-style-type: none"> - based on the conversations in the previous step, the children suggest what else could be done (for example, to name the bridge, make a fence, fix the pillars so that the bridge does not collapse, make a river, plants, animals, arrange the landscape, etc.) <p>NOTE: In addition to LEGO material, other materials may also be used: paper, nylon, foil, fabric, various bottles, etc.)</p>

Reliability of the instrument was examined for each scale and very high coefficients of the Cronbach's Alpha internal consistency were obtained for each of them (Table 3). By examining the parameters of asymmetry and kurtosis, we found that the distribution is approximate to the normal, since all the parameters of kurtosis are positive, indicating that more results are accumulated around the distribution centre,

which can be justified partly due to the nature of the construct we measured and partly due to the size of the sample.

Table 3

Descriptive data and reliability of scale on the reflection of the application of the LEGO DUPLO Play Box materials in learning activities and free play in relation to kindergarten teachers

Scale	\bar{X}	$s\delta$	Item No.	α	skewness	kurtosis
Planning learning activities	4.70	0.48	3	.80	-1.79	2.67
Introductory part of the learning activity	4.35	0.69	4	.91	-1.39	2.18
Main part of the learning activity	4.42	0.51	8	.85	-1.53	3.69
Final part of the learning activity	4.48	0.58	4	.81	-0.85	0.30
Free children's play	4.49	0.50	6	.69	-1.06	0.35

The second part of the instrument was constructed based on the presented aspects of child development: physical, social and emotional, intellectual, and development of speech, communication and creativity of the six-year olds, taken from the *Programme of Early Childhood and Preschool Education* (Spasojević, Pribišev Beleslin, & Nikolić, 2007). During the study of the connection between attending preschool programmes and early learning, when trying to determine whether attending a preschool programme determines early learning of children (Cvijanović, 2017), after checking the instrument through factor analysis and Principal Axis method, 85 items classified into four subscales were reduced to 55 and used in this study. Each item was assessed on the Likert-type scale with numbers 1 to 5, indicating the intensity of the manifestation of a particular development indicator. Within both scales, the one which recorded the reflection of the application of the LEGO DUPLO Play Box material in relation to kindergarten teachers, and the one which recorded the reflection of the application of the LEGO DUPLO Play Box material in relation to the aspects of child development, the Cronbach's Alpha internal reliability coefficients have been calculated for each subscale. The coefficients indicate high reliability of each of them (Table 4). Skewness and kurtosis of distribution indicators shown in Table 4 also point to its normality.

Table 4

Descriptive data and reliability of scales on the reflection of the application of the LEGO DUPLO Play Box materials in learning activity in relation to the aspects of child development

Scale	\bar{X}	$s\delta$	Item No.	α	skewness	kurtosis
Physical development	4.19	0.75	5	.90	-1.04	0.96
Social and emotional development	4.07	0.70	12	.95	-0.74	0.47
Intellectual development	3.89	0.85	22	.97	-1.09	1.24
Speech, communication and creativity	4.25	0.74	16	.97	-1.22	0.91

The sample in the research was composed of 30 kindergarten teachers from four preschool institutions: Public Institution - Children's Kindergarten "Neven",

Čelinac; Public Institution - Children's Kindergarten "Čika Jova Zmaj", Bijeljina; Public Institution - Children's Kindergarten "Radost", Šamac and Public Institution - Children's Kindergarten "Majka Jugovića", Doboj. All these kindergartens were included in the project "The use and application of LEGO construction materials", carried out in 2014, after the LEGO Foundation from Denmark provided LEGO DUPLO Play Box material and training for kindergarten teachers from these institutions, which had been partially or completely destroyed in catastrophic floods that zamijeniti s occurred in Bosnia and Herzegovina earlier that year. During the implementation of the aforementioned project, after the first training was organized, a group of kindergarten teachers trained for the use of this material was formed. Through the appointed supervisor of the Ministry of Education and Culture, they received clear guidelines on how to use LEGO material in the educational process. The second training was organized in April 2015, after half a year of the use of the materials as part of learning activities and free play. Then the kindergarten teachers prepared "diaries on successful" use of LEGO materials based on the defined *LEGO steps for kindergarten teachers* (Table 2).

By electronic means, at the beginning of 2017, these kindergarten teachers provided completed instruments on the basis of which data were collected enabling us to perform statistical data processing that involved the calculation of the arithmetic mean, standard deviations, Pearson coefficient of correlation, as well as the use of statistical techniques of multivariate variance analysis (MANOVA).

Results

Based on the assessment of the kindergarten teachers about the possibility of application of the *LEGO DUPLO Play Box* material in the conditions under which their preschool institution is operating, data were collected which, based on descriptive indicators, show that two opposed groups of factors were identified: intrapersonal factor, interpersonal factor and public policy on the one hand, and the institutional factor and the community factor on the other hand (Figure 1).

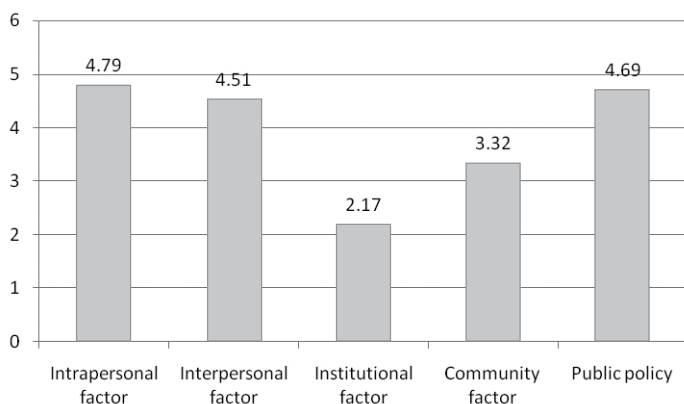


Figure 1. Presentation of socio-ecological factors through the arithmetic mean

The kindergarten teachers' most dominant belief is that they have knowledge on the importance of construction play, and the ability to plan learning activities in which construction material is used. They are also confident that they have the efficiency that is reflected in the skill to use LEGO material in immediate educational work (intrapersonal factor). They also believe that public policy, viewed through the Law on Preschool Education, clearly defines the importance of play for the development of a child, and that the preschool programme clearly emphasizes that play is one of the methods of applying the official preschool programme. They also believe that the institution in which they work is determined to make play the dominant activity in learning activities, and that there is a strong willingness of kindergarten teachers within the institution to exchange experiences regarding the application of the LEGO material (interpersonal factor).

The assessment of the kindergarten teachers is focused on the belief that the community as a factor, reflected through the prism of the social network, public rules and norms, does not provide significant support in terms of promoting and emphasizing the importance and significance of the construction play for children and for their further development, as well as for various thought processes that will later be used to acquire the necessary academic knowledge. In addition, the expressed views indicate that the institutional factor (associations, organizations, shops selling toys) does not sufficiently promote the importance of the play itself. Our second research task was focused on examining the bonds between the use of LEGO material and organized learning activities as well as free children's play.

By analysing the collected data with the Pearson coefficient we found that the correlations between the elements of the structure of learning activities and free play are generally statistically significant (Table 5), although the observed main part of the learning activity has been separated from other elements. We should bear in mind that the correlation between this element and planning of the learning activity and its introductory part has not been noticed. Given that the correlations of the selected factors are generally significant, we can still say that there is a coherence of the scale measurement range.

Table 5

Correlations between the elements of the structure of learning activities and free play

	planning	introductory activity	main activity	final activity	free play
planning	1	.77(**)	.18	.50(**)	.62(**)
introductory activity		1	.31	.67(**)	.42(*)
main activity			1	.71(**)	.61(**)
final activity				1	.57(**)
free play					1

** correlation is significant at 0.01

* correlation is significant at 0.05

Significant correlations between free children’s play and all elements of the structure of learning activities indicate that LEGO material can be successfully used during learning activities; that is, free children’s play, as a “medium” for learning and development (Bergen, 1998, p. 7), is firmly bound to learning activity, regardless of the fact that learning activity is viewed as a clearly “set micro-entity, a well-conceived rounded idea of content and procedures corresponding to one of the outcomes, or it can act integratively on more defined learning outcomes, in the course of an acceptable time unit, according to the majority of theoreticians, for the period of 20-25 minutes” (Spasojević, 2013, p. 156).

In order to examine the effects of the use of the LEGO DUPLO Play Box material on the practice of preschool institutions, as well as the contribution of the LEGO DUPLO Play Box materials to the development of preschool children, if used during learning activities, a multivariate variance analysis (MANOVA) was used to determine whether there is a difference between the groups in terms of the impact on a variable when the *Application of LEGO material* was chosen as an independent variable. The dependent variables were scores on four subscales of child development (physical development, social and emotional development, intellectual development, and speech development, communication and creativity).

The results show that there is an effect of the use of LEGO material in the *Programme of Early Childhood and Preschool Education*, but only in the context of the way kindergarten teachers use learning activities and free children’s play. The indicator of statistical significance is the linear combination of Wilks’ Lambda (λ - 0.001), $F(2.1386)$ with a level of significance $p = .008$. By insight into the Box’s Indicator M, the assumption of the homogeneity of the co-variance matrices is not distorted (Sig. - 0.195).

Table 6
Box’s Test for Equality of Covariance Matrices

Box’s M	24.164
F	1.296
df1	15
df2	3156.632
Sig.	.195

The results of the test of effects between the usage of LEGO materials and learning activities and free children’s play are presented in Table 7.

Table 7
Significance of the use of LEGO material in the Programme of Early Childhood and Preschool Education through parts of the activity and free children’s play

Dependent Variable		F	p	Partial Eta Squared
Independent variable: Application of LEGO material	Planned learning activities	7.632	0.001	0.926
	Introductory part of learning activities	53.46	0.000	0.989
	Main part of learning activities	11.89	0.000	0.951
	Final part of learning activities	5.853	0.002	0.905
	Free children’s play	3.464	0.002	0.85

However, when considering the use of LEGO material and the aspects of child development, the effect was not noticed (Table 8), which means that there is no difference in achieving the expected learning outcomes during the application of the Programme with and without LEGO material where the indicator of statistical significance is a linear combination of Pillai's Trace - 3.041815, F (1.940009), Wilks' Lambda (λ - 0.001), F (2.1386), Roy's Largest Root - 16.07833, F (9.825647) with significance level $p = .305$.

Table 8

Significance of the use of LEGO material in the programme of preschool education and child development: univariate effects

Independent variable: Application of LEGO material	Dependent variable	F	p
	Physical development	1.495	0.251
	Social and emotional development	1.800	0.160
	Intellectual development	0.992	0.523
	Development of speech, communication and creativity	2.085	0.107

Discussion

The insight into the above results points to specific kind of relationships and connections between the application of the construction toys in the preschool programme and the conditions in which the preschool institution where such programme is carried out operates. In the context of socio-ecological theory, it has been noticed that kindergarten teachers recognize the importance of children's play and are supported in their kindergarten to use play as a dominant activity. They also notice that organizations around kindergartens and the local community itself do not recognize the importance and significance of play, because in almost all communities, kindergarten teachers have assessed that the community, viewed through the social network and organizations that act in it, does not believe that play contributes to the acquisition of academic knowledge and child development in general. The observed tendencies are in line with research in which interpersonal, intrapersonal and policy factors have been recognized as the main influences, from kindergarten teachers' point of view. The findings of previous studies, which used traditional methods of exploring teachers' perspectives regarding the use of play in kindergartens (Lynch, 2015), have been confirmed.

The analysis of relationships between the use of LEGO materials and learning activities and free children's play points to the separation of the main activity within the very structure of the learning activity in relation to planning and its introductory part, which may be the result of kindergarten teachers' inadequate preparation for the learning activity in which the dominant material is LEGO. That has also been detected in the introductory part of the learning activity. However, the significant correlations of free children's play and all elements of learning activities emphasize the nature of

the programme that is based, as we have mentioned, on play without a strictly defined structure, but with clear instructions for work. That is in accordance with research that specifically emphasized the *process* while playing with blocks (Verdine, Golinkoff, Hirsh-Pasek, Newcombe, Filipowicz, & Chang, 2014), which was also emphasized in this project, since kindergarten teachers underwent training for the use of LEGO material led by LEGO Foundation expert prior to the use of those materials.

Examination of the contribution of LEGO material to the development of children has shown that there is no difference in their expression in cases where LEGO material is used in the kindergarten and when it is not used in teaching activities. LEGO material has more influence on how kindergarten teachers will be involved in the process of early learning of children and how they will be prepared, and then how they will realize the planned tasks while working with children. We believe that this is due to the offered methodological model by the LEGO Foundation (LEGO steps for kindergarten teachers), which was used by kindergarten teachers, and which differs from the methodological model that is applied in the practice of all preschool institutions in the Republic of Srpska, Bosnia and Herzegovina. What is encouraging about these results is that kindergarten teachers rely on other resources available to them in kindergarten, but the programme itself, due to its nature, enables that. In addition to this, there are several assumptions on the basis of which the reasons for obtaining such results can be sought.

We can assume that each group did not have a sufficient number of construction elements for play. Four kindergartens with 29 educational groups and 677 children received 60 packages of average weight of six kg per package. This means that almost two packages were used for each group with 30 children. The findings of other studies show that for a group of 15 to 20 children it is necessary to provide at least 240 construction elements of a unique shape (Wellhausen Tunks, 2009, p. 4) in order to see the effects of their application.

One of the reasons for such results might lie in the defined structure of the preschool programme and the whole web of interactions of different dimensions of each preschool institution, since each preschool is specific, unique with its entire context, authentic culture and climate, as well as educational practice that is created in it.

Conclusions

Considering the importance of construction toys for the development of a child, it is important to know the position of such toys in a preschool institution and how kindergarten teachers assess their own attitude and that of the others towards the nature of a child, which relies on play.

One of the possible implications of this paper can be found in recognizing the importance of kindergarten teachers in promoting the construction game as an intuitive, implicit conceptual foundation for kindergarten teachers (Pirrone, Amata, Cerniglia, & Di Nuovo, 2015), paying particular attention to the used materials, planned time and space, and interaction between a child and a kindergarten teacher (Hobenshield Tepylo, Moss, & Stephenson, 2015).

The results of our research point to the need to review the conditions and create community-based programmes based on socio-ecological principles, and support an integrated multidisciplinary perspective (Stokols, 1996) in order to create better opportunities for emphasizing the importance of play for the child. In that way an environment where such conditions are created can earn a status of *Town - Friend of children*.

At the same time, it is necessary to further improve the outcome network in the *Programme of Early Childhood and Preschool Education* so that these outcomes can be achieved through play, because, as we have said, play is the best medium for teaching a child; that is, learning is best achieved through play.

Reference

- Asher, S., & Rose, A. (1999). Promicanje dječje društveno-emocionalne prilagodbe vršnjacima. In P. Salovey, & D. J. Sluyter (Eds.), *Emocionalni razvoj i emocionalna inteligencija* (pp. 261–295). Zagreb: Educa.
- Bergen, D. (1998). *Readings from... Play as a Medium for Learning and Development*. Olney, MD: Association for Childhood Education International.
- Bredenkamp, S. (1996). *Kako djecu odgajati. Razvojno primjerena praksa u odgoju djece od rođenja do osme godine*. Zagreb: Educa.
- Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, 22(6), 723–741. <https://doi.org/10.1037/0012-1649.22.6.723>
- Caldera, Y. M., Culp, A. M., O'Brian, M., Truglio, R. T., Alvarez, M., & Huston, A. (1999). Children's play preferences, construction play with blocks and visual spatial skills: Are they related? *International Journal of Behavioral Development*, 23, 855–872. <https://doi.org/10.1080/016502599383577>
- Cecchin, D. (2013). Pedagogical Perspectives on Play. In I. Schousboe, & D. Winther-Lindqvist (Eds.), *Children's Play and Development: Cultural-Historical Perspectives* (pp. 55–71). Springer: Dordrecht, Heidelberg, New York, London. https://doi.org/10.1007/978-94-007-6579-5_4
- Cvijanović, N. (2017). *Predškolski program i dječiji razvoj: teorijski i empirijski pristup*. Istočno Sarajevo: Zavod za udžbenike i nastavna sredstva.

- Ferrara, K., Hirsh-Pasek, K., Newcombe, N. S., Michnick Golinkoff, R., & Shallcross Lam, W. (2011). Block Talk: Spatial Language During Block Play. *Journal Compilation: International Mind, Brain, and Education Society and Blackwell*, 5(3), 143–151. <https://doi.org/10.1111/j.1751-228X.2011.01122.x>
- Frost, L. J. Wortham, C. S., & Reifel, S. (2012). *Play and Child Development* (4th edition). New Jersey: Pearson Education.
- Hirsch, E. (1996). *The block book*. Washington, DC: National Association for the Education of Young Children.
- Hobenshield Tepylo, D., Moss, J., & Stephenson, C. (2015). Blocks: Great Learning Tools from Infancy Through the Primary Grades: A Developmental Look at a Rigorous Block Play Program. *Young Children*, 70(1), 18–25. Retrieved from www.naeyc.org.
- Holbert, N., Penney, L., & Wilensky, U. (2010). Bringing Constructionism to Action Game-Play. *Constructionism*, 1–7.
- Hussain, S., Lindh, J., & Shukur, G. (2006). The effect of LEGO Training on Pupils' School Performance in Mathematics, Problem Solving Ability and Attitude: Swedish Data. *Educational Technology & Society*, 9(3), 182–194.
- Ivon, H. (2010). *Dijete, odgojitelj i lutka*. Zagreb: Golden marketing-Tehnička knjiga.
- Kamenov, E. (2006). *Dečija igra*. Beograd: Zavod za udžbenike i nastavna sredstva.
- Lynch, M. (2015). More play, Please. The Perspective of Kindergarten Teachers on Play in the Classroom. *American Journal of Play*, 7(3), 347–370.
- McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An Ecological Perspective on Health Promotion Programs. *Health Education Quarterly*, 15(4), 351–377. <https://doi.org/10.1177/109019818801500401>
- Mojić, D. (2010). Program predškolskog vaspitanja i obrazovanja u Republici Srpskoj kao savremeni multifunkcionalni kurikulum. *Nova škola* (VII), 187–198.
- Oostermeijer, M., Boonen, A., & Jolles, J. (2014). The relation between children's constructive play activities, spatial ability and mathematical word problem solving performance: A mediation analysis in sixth grade students. *Frontiers in Psychology*, 5:782. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4102248/>, <https://doi.org/10.3389/fpsyg.2014.00782>
- Papert, S. (1980). *Mindstorms. Children, Computers and Powerful Ideas*. New York: Basic Books.
- Papert, S. (1993). *The Children's Machine: Rethinking School in the Age of the Computer*. New York: Basic Books.
- Petrović-Sočo, B. (2009). Značajke suvremenog naspram tradicionalnog kurikuluma ranog odgoja. *Pedagoška istraživanja*, 6(1-2), 123–138.
- Piaget, J. (1962). *Play, dreams and imitation in childhood*. New York: Norton Press.
- Pijaž, Ž., & Inhelder, B. (1978). *Intelektualni razvoj deteta*. Beograd: Zavod za udžbenike i nastavna sredstva.

- Pirrone, C., Amata, C.G., Cerniglia, S., & Di Nuovo, S. (2015). Playing with Building Block: a Way to Improve Numerical Intelligence and Nonverbal Reasoning. *Procedia - Social and Behavioral Sciences*, 1–6. Retrieved from file: ///D:/Dokumenti/Downloads/ProcediaSBS_conferenceWCLTEL.pdf
- Pirrone, C., Nicolosi, A., Passanisi, A., & Di Nuovo, S. (2015). Learning Potential in Mathematics through Imagination and Manipulation of Building Blocks. *Mediterranean Journal of Social Sciences*, 6(4), 152–159. <https://doi.org/10.5901/mjss.2015.v6n4s3p152>
- Ramani, G. B., Zippert, E., Schweitzer, S., & Pan, S. (2014). Preschool children's joint block building during a guided play activity. *Journal of Applied Developmental Psychology*, 35, 326–336. <https://doi.org/10.1016/j.appdev.2014.05.005>
- Rossen, L. H. (2013). Play to Learn, Learn to Play: Boundary Crossing Within Zones of Proximal Development. In I. Schousboe, & D. Winther-Lindqvist (Eds.), *Children's Play and Development: Cultural-Historical Perspectives* (pp. 141–165). Springer: Dordrecht, Heidelberg, New York, London. https://doi.org/10.1007/978-94-007-6579-5_9
- Spasojević, P. (2013). *Metodika predškolskog vaspitanja i obrazovanja*. Banja Luka: Nova škola plus.
- Spasojević, P., Pribišev Beleslin, T., & Nikolić, S. (2007). *Program predškolskog vaspitanja i obrazovanja*. Ministarstvo prosvjete i kulture Republike Srpske, Istočno Sarajevo: Zavod za udžbenike i nastavna sredstva.
- Stokols, D. (1996). Translating Social Ecological Theory into Guidelines for Community Health Promotion. *American Journal of Health Promotion*, 282–298. <https://doi.org/10.4278/0890-1171-10.4.282>
- Trawick-Smith, J., Russell, H., & Swaminathan, S. (2010). Measuring the Effects of Toys on the Cognitive, Creative, and Social Play Behaviors of Preschool Children. *Early Child Development and Care*, 181(7), 909–927. <https://doi.org/10.1080/03004430.2010.503892>
- Wellhousen Tunks, K. (2009). Block Play: Practical Suggestions for Common Dilemmas. *Dimensions of Early Childhood*, 37(1), 3–8.
- Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., Newcombe, N. S., Filipowicz, A. T., & Chang, A. (2014). Deconstructing Building Blocks: Preschoolers' Spatial Assembly Performance Relates to Early Mathematics Skills. *Child Development*, 85(3), 1062–1076. <https://doi.org/10.1111/cdev.12165>
- Vigotski, L. (2005). *Dečija mašta i stvaralaštvo*. Beograd: Zavod za udžbenike i nastavna sredstva.
- Wolfgang, C. H., & Wolfgang, M.E. (1999). *School for young children: Developmentally appropriate practices*. Boston: Allyn and Bacon.
- Wolfgang, S., Stannard, L., & Jones, I. (2001). Block Play Performance Among Preschoolers as a Predictor of Later School Achievement in Mathematics. *Journal of Research in Childhood Education*, 15(2), 173–180. <https://doi.org/10.1080/02568540109594958>
- Wolfgang, C. H., Stannard, L. L., & Jones, I. (2003). Advanced constructional play with LEGOs among Preschoolers as a Predictor of later school achievement in mathematics. *Early Child Development and Care*, 173(5), 467–475. <https://doi.org/10.1080/0300443032000088212>
- Vudhed, M. (2012). *Različite perspektive o ranom detinjstvu: teorija, istraživanje i politika*. Beograd: Institut za pedagogiju i andragogiju Filozofskog fakulteta.

Nataša Cvijanović,

Ministry of Education and Culture of the Republic of Srpska,
Miloša Dujića 22 A, 51000 Banja Luka, Bosnia and Herzegovina
natasa.c09@gmail.com

Danica Mojić

Children's Kindergarten Čika Jova Zmaj
Majora Gavrilovića 16/4, 76300 Bijeljina, Bosnia and Herzegovina
mojic.danica@gmail.com

LEGO materijal u programu predškolskog odgoja i obrazovanja

Sažetak

U radu su prikazane mogućnosti i uvjeti primjene LEGO DUPLO PlayBox materijala, kao i efekti njegove uporabe na razvoj djeteta i na rad odgojitelja na temelju provedenog istraživanja u četiri predškolske ustanove u Bosni i Hercegovini koje su bile uključene u projekt "Uporaba i primjena LEGO konstruktorskog materijala u predškolskim ustanovama". U okviru projekta, materijal i obuka za korištenje materijala bili su osigurani od danske LEGO Fondacije koja podržava realizaciju takvih aktivnosti u Južnoafričkoj Republici, Meksiku i Indiji, a od europskih zemalja u Ukrajini i Bosni i Hercegovini. Trideset odgojitelja procjenjivalo je mogućnosti i uvjete primjene LEGO DUPLO PlayBox materijala putem Skale procjene o primjeni LEGO materijala u Programu predškolskog odgoja i obrazovanja. Efekti uporabe LEGO DUPLO PlayBox materijala na razvoj djeteta, ali i na rad odgojitelja, praćeni su putem Protokola za promatranje aktivnosti koja se uči, a u kojoj se koristi LEGO materijal i to s refleksijom u odnosu na odgojitelja i u odnosu na razvojne aspekte djece. Rezultati ispitivanja pokazuju da zajednica kao čimbenik ne pruža značajnu potporu u pogledu promocije i naglašavanja važnosti konstruktorske igre za djecu i za njihov daljnji razvoj, te da institucionalni čimbenik (udruge, organizacije, trgovine koje prodaju igračke) u dovoljnoj mjeri ne promovira važnost igre. Osim toga, utvrđeno je da postoji efekat upotrebe LEGO materijala u Programu predškolskog odgoja i obrazovanja, ali samo u kontekstu načina rada odgojitelja. Efekt upotrebe LEGO materijala na razvojne aspekte djece nije primijećen, što znači da nema razlika u dostizanju očekivanih ishoda učenja djece tijekom primjene Programa s LEGO materijalom ili bez njega. To implicira da je primjena cjelokupnog Programa predškolskog odgoja i obrazovanja u Republici Srpskoj, Bosni i Hercegovini, utemeljena na igri, pa tako i na konstruktorskoj igri, ali i da je primjenom LEGO materijala moguće ostvariti planirane ishode učenja i na taj način potaknuti razvoj djeteta u svim njegovim aspektima.

Ključne riječi: aspekti dječjeg razvoja; igrajuća aktivnost; konstruktorski materijal; pedagoška perspektiva igre; socijalno-ekološka teorija.